Name ________________________________ Period ________

Simulating Radioactive Decay: The Half-Life of M&Mium

<u>Discussion</u>: Many people have heard the term "half-life" and know that it is related to radioactive elements. The **half-life** of an element is the time it takes half of the radioactive atoms to **decay**. Another way to think of this is, "the time required for half of any given amount of a radioactive substance (parent atoms) to decay into another substance (daughter atoms)". Radioactive decay is a constant process where the unstable radioactive element breaks down to become a more stable element by releasing radioactive particles and radiation. In this lab you will use M&Ms to simulate how atoms radioactively decay and how rocks of different ages have different amounts of radioactive and decayed elements.

<u>Background Information:</u> Testing of radioactive minerals in rocks best determines the absolute age of the rock.

In radiometric dating, different isotopes of elements are used depending on the predicted age of the igneous rocks. Potassium/Argon dating is good for rocks 100,000 years old since Potassium 40 has a half-life of 1.3 billion years! Uranium/Lead dating is used for the most ancient rocks, since U-238 has a half-life of 4.47 billion years.

By comparing the percentage of an original element (parent atom) to the percentage of the decay element (daughter atom), the age of a rock can be calculated. The ratio of the two atom types is a direct function of its age because when the rock was formed it had all parent atoms and no daughter atoms.

Purpose: The purpose of this activity is to simulate the process of radioactive decay and to illustrate the concept of half-life.

Materials:
50 M&Ms, paper plate, plastic cup, index card, graph paper

Procedure:

1. Before you begin, wash your hands and then collect your materials.

2. Obtain a bag of M&Ms and count the total number of M&Ms in the bag. Record this number on your data table. Do not eat any of the M&Ms until you've completed the experiment!

3. For the rest of the experiment, we're making the following assumptions:
    a. The M&M candies are now atoms of a radioactive element called "M&Mium."
    b. When the white "M" is facing upward, the atom has not yet decayed.
    c. When the white "M" is facing downward, the atom has decayed.

4. Pour the M&Ms in a plastic cup, cover with an index card and shake vigorously. Then, pour the M&Ms onto the paper plate on your lab table. Be careful not to spill the M&Ms or allow

them to touch the lab table. Keep the candy on the paper plate at all times.

5. Remove the M&Ms that have decayed (the M&Ms with the “M” face down) and set them aside. Count how many undecayed (radioactive) atoms remain and record this number in your data table.

6. Place the remaining undecayed M&Ms in your plastic cup. Repeat steps 4 and 5 until you’ve completed your data table. At this point, you should have data for a total of 5 half-lives.

7. Following your teacher’s instructions, pool your data with the rest of the class and record the totals in your data table.

Data Table for the Radioactive Decay of M&Mium

Half-Lives	# of Undecayed M&Ms (group data)	# of Undecayed M&Ms (class data)
0		
1		
2		
3		
4		
5		

Questions (please answer on separate paper):

1. Construct a graph for your group’s data. Plot the number of half-lives on the x-axis and the number of undecayed on the y-axis. Choose an appropriate scale that fills the page. Include a title and label your axes.

2. On the same graph, plot the class data. Use a different colored pen or pencil and create a key to differentiate between the two lines.

3. Describe the appearance of the two lines on your graph. Are they straight or curved? What does this tell you about the relationship between the number of half-lives and the number of undecayed atoms?

4. Which set of data provides a more convincing demonstration of half-life: your group’s data or the class data? Why?

5. Suppose you had 600 atoms of M&Mium. How many undecayed atoms would remain after three half-lives? Show work.

6. Suppose you start with 3000 atoms of M&Mium and only 190 remain. How many half-lives must have passed? Show work.
7. Describe one similarity and one difference between this model (M&Ms) and actual radioactive decay.

8. In this simulation, can you predict when a specific M&M will decay? Why or why not?

9. What other household items could we use in this experiment to model radioactive decay?

Extra Credit Questions:

1. How could you modify this activity to demonstrate that different isotopes of an atom can have different half-lives?

2. Suppose you had 1 trillion M&Ms (that's 1,000,000,000,000 M&Ms). After 10 half-lives, is it likely that any M&Ms would remain undecayed? How about after 100 half-lives? Explain your answers and show work, if necessary.